SEAGRASS MEADOWS

Richard K.F. Unsworth, Leanne C. Cullen-Unsworth

What are seagrasses?

Seagrasses are flowering plants adapted to life in the oceans. They are the only angiosperms able to withstand a saline existence, with all but one genus capable of completing their lifecycle in a fully submerged marine environment. Seagrasses comprise a relatively small group of plants, with 72 recognised species from four families of the plant order Alismatales. The comparatively low diversity of seagrass plants is counterbalanced by the high abundance and diversity of other organisms occupying the highly productive meadow ecosystems that these plants create. Seagrass meadows range in size and density from small 1m^2 patches to extensive continuous meadows covering tens of thousands of hectares. Meadows can be monospecific or comprise multispecies communities with up to 12 seagrass species present.

Just like terrestrial angiosperms, seagrasses flower fruit and seed, with sexual reproduction facilitated (enabling pollination and movement of seeds and propagules) by animals as well as water movement (currents) [1]. Although sexual reproduction is key to maintaining diversity and adaptation, seagrasses also utilise asexual reproduction which is important for meadow growth.

Where do seagrasses live?

Seagrasses are present in shallow seas on the continental shelf of all continents except Antarctica (Figure 1). Documented distributions include 125,000 km^2 globally but estimates suggest seagrass meadows cover more than 600,000km^2 of the coastal ocean.

Seagrass meadows are largely soft sediment intertidal to subtidal benthic habitats that thrive in sheltered environments such as shallow embayments, lagoons and estuaries where wave attenuation is limited and light and nutrient levels are sufficient. Depth distribution is largely controlled by the availability of light with tidal exposure, wave action, associated turbidity, and low salinity determining seagrass survival at their shallow edge. Intertidal seagrass is prevalent where there is sufficient shelter from wave action or where there is entrapment of water at low tide providing protection from exposure [2].

Why are seagrasses defined as ecological engineers?

Seagrass plants are termed ecological engineers as they significantly modify their environment by attenuating currents and waves and reducing nutrient levels, decreasing turbidity thereby enhancing conditions for optimal growth. The more extensive the area and denser the seagrass meadow, the greater the capacity to facilitate positive feedbacks ensuring affable conditions [3].

Seagrasses enhance their own survival in sulphide rich and otherwise toxic sediments by exuding oxygen from their roots into what would be anoxic mud. This action is supported by a three way symbiosis between the seagrass, lucinid bivalves, and their sulphide-oxidizing gill bacteria. The symbiosis results in reduced sulphide stress for seagrasses, with provision of organic matter and radial oxygen release from the seagrass roots for the bivalves and their endosymbionts [4].

Why are seagrass meadows important?

The benefits that humans derive from seagrass meadows are termed “ecosystem services”. Some of these services span the global seagrass range, such as water filtration, habitat provision, fish nursery grounds and biodiversity support, but local variation occurs in the services exploited and goods extracted [5].

Their provision of fish feeding and nursery habitat is often cited as rationale for seagrass protection. This is because seagrasses provide shelter from predators and an abundant food supply, such as small crustaceans, supporting fish stocks [6]. There is growing recognition for the value of seagrass in supporting diverse and productive fauna that creates rich fishing grounds delivering a source of food security [7]. For example, at low tide, exposed seagrass meadows in the tropics provide an accessible hunting ground for small fish and edible invertebrates. At other times traps and nets are used to catch predatory fish that migrate in and out of seagrass (Figure 2). The Atlantic Cod (*Gadus morhua*) is the world’s third most landed fish species. This historically important fishery species favours seagrass as a nursery ground, with evidence suggesting that juvenile cod grow faster and have improved chances of reaching maturity when living in seagrass meadows.[6].Seagrass meadows also play a significant role in climate change mitigation though carbon storage within their sediments. Estimates suggest that seagrass meadows can bury carbon 40 times faster than tropical forests and provide one of the greatest contributions to the total carbon buried in ocean sediments [8]. Because seagrasses are net photosynthesisers and are highly productive, they also rapidly utilise carbon from the water column. This has resulted in considerable attention being given to the role seagrass plays in altering seawater chemistry and potentially buffering small-scale impacts of ocean acidification on calcifying fauna such as corals and molluscs [9].

What is the future outlook for seagrass meadows?

The ecological value of seagrass meadows is irrefutable yet they remain in decline [10] and largely marginalised on conservation agendas. Action is required to stem the loss of the world’s seagrass meadows and prioritise protection based on their array of ecosystem services.

As the human population grows environmental impacts increase. Poor water quality (particularly elevated nutrients) as a result of poor catchment management together with a diverse range of pollution sources is the biggest threat to seagrasses globally. Water quality problems are particularly acute in developing countries with rapidly growing economies, where municipal infrastructure and environmental legislation are lacking. Coastal development is a threat with boating, tourism, aquaculture, ports, energy projects and housing developments all placing pressure on seagrass systems. Local and regional threats to seagrass exacerbate the impacts of climate change, ocean acidification and sea level rise. Minimising local stress on seagrass will support their capacity to remain resilient to the impacts of larger scale, longer term stressors. This means improving local water quality, preventing damage from destructive fishing practices, including seagrasses in Marine Protected Areas, preventing overexploitation of seagrass fisheries and mitigating stress from coastal development [11]. Bold steps are required to ensure the recovery and restoration of these habitats but the cumulative effect of multiple small scale actions can work towards a brighter future for these underappreciated undersea gardens.

References

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Where can I find out more?

Project Seagrass: International seagrass conservation charity www.projectseagrass.org

SeagrassWatch: International seagrass monitoring network www.seagrasswatch.org

World Seagrass Association: International association of scientists and conservationists interested in seagrass conservation and biology wsa.seagrassonline.org

Figure 1. Left. Seagrasses such as this germinating Zostera marina seed are monocotyledons. Right. Seagrass meadows are one of the worlds most productive marine habitats such as this Zostera marina meadow in North Wales (UK).

Figure 2. Fishing activity in seagrass meadows is globally extensive, such as these women collecting intertidal invertebrates in Mozambique (Left) and the widespread use of nets to catch abundant fish in Indonesia (right).